

On-Orbit Assembly of a Universally Interlocking Modular Spacecraft (7224-110), Phase I

Completed Technology Project (2004 - 2004)



Project Introduction

Physical Sciences Inc. and Advanced Solutions, Inc. propose a novel approach for on-orbit assembly of a modular spacecraft using a unique universal, intelligent, electromechanical interface (AUTOCONNECT) on surfaces of individual modules. AUTOCONNECT not only provides mechanical fastening between modules (irrespective of relative alignments and orientations), but also automatically configures electrical connections among modules. Mechanical attachment occurs due to docking and physical contact between modules with sufficient initial momenta. The transmitted forces during docking will be much less than the launch forces for which the spacecraft modules are designed. The mass properties of the module assembly are determined on orbit and the entire assembly functions as a spacecraft unit. Benefits of on-orbit assembly using AUTOCONNECT include: (i) Configurability; mission-specific spacecraft construction by assembling desired subsystem modules (ii) Reconfigurability; adapt to new missions by adding new, advanced technology modules, (iii) On orbit Repair/Refurbishment of existing spacecraft with new, advanced technology subsystems/payloads, and (iv) Lower costs and increased space access by launching smaller and lighter spacecraft modules. In Phase I, we will demonstrate autoconfiguration of electrical connections between two AUTOCONNECT-equipped modules. We will experimentally simulate the docking and on-orbit assembly of up to three modules, including real-time mass properties determination and attitude control.

Anticipated Benefits

Military applications include on-orbit assembly of spacecraft from specific subsystems needed for a particular mission, creation of new spacecraft configurations, or reconfiguration of existing spacecraft. Non-space military applications of AUTOCONNECT include soldiers' clothing, where sensors, communications equipment, instruments, etc, can be simply attached as needed for the battlefield environment. AUTOCONNECT allows assembly of systems without connectors and cables, e.g., computer and home electronic systems, "smart" walls in buildings, where sensors/monitors can be attached anywhere, etc. Elimination of connectors and cables will make systems lighter, more compact, and improve both the aesthetics and safety at home and the workplace. The proposed technology will enable NASA to build large systems in space using smaller, modular subsystems, refurbish spacecraft already in orbit with new technology subsystems/payloads, and service/repair existing subsystems. This modular, on-orbit assembly approach, combined with our concept of modular spacecraft architectures, is especially suited for NASA's vision of swarms or fleets of spacecraft flying in formation on distributed science missions. Cost is reduced by manufacturing identical modules in large quantities, but in addition, our approach allows the selection of desired modules and their assembly into a customized spacecraft using AUTOCONNECT and the advanced control algorithms we propose to develop.



On-Orbit Assembly of a Universally Interlocking Modular Spacecraft (7224-110), Phase I

Table of Contents

Project Introduction	1
Anticipated Benefits	1
Organizational Responsibility	1
Primary U.S. Work Locations and Key Partners	2
Project Management	2
Technology Areas	2

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

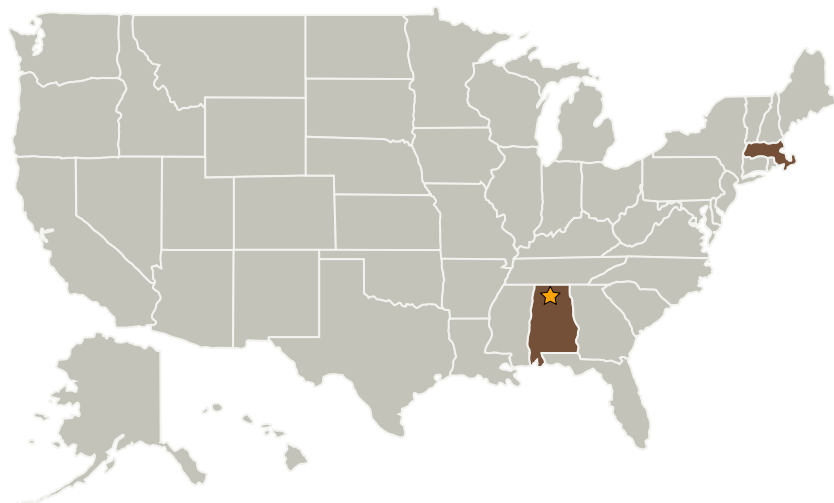
Small Business Innovation Research/Small Business Tech Transfer

On-Orbit Assembly of a Universally Interlocking Modular Spacecraft
(7224-110), Phase I

Completed Technology Project (2004 - 2004)



Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Physical Sciences, Inc.	Supporting Organization	Industry	Andover, Massachusetts

Primary U.S. Work Locations

Alabama	Massachusetts
---------	---------------

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Louis F Lollar

Principal Investigator:

Prakash Joshi

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.2 Observatories
 - └ TX08.2.3 Distributed Aperture